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A contribution to the validation of Italian eHEALS scale for the Italian population

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Abstract: *Background*: Modern technology allows people to search for various information on the Internet, including health information. The eHEALS scale measures and assesses the ability for consumers to find, judge and apply health information found towards health problems. The Italian version of the eHEALS scale was validated using the Principal-Component Analysis (PCA) technique. Even if the results were satisfactory and the scale was considered validated, psychometric scaling literature is also recommended to subject the scale itself to a Confirmatory Factor Analysis (CFA) for a more sound and complete validation process. *Methods*: The sample consisted of 349 Italian participants. Each participant was administered Italian versions of the eHEALS scale, the Rosenberg's self-esteem scale, The Anxiety - Adult (PROMIS Emotional Distress – Anxiety) - Short Form, the Locus of Control of Behavior Test and the General Self-Efficacy Scale. Several psychometric tests were also performed to investigate the validity and reliability of the test, including the CFA. *Results*: Analysis of the data showed satisfactory psychometric characteristics and confirmed the scale's unidimensional properties. The eHEALS eight items scale items had acceptable correlations with the eHEALS test total (min=0.780, max=0.867). Furthermore, factor loadings were significant (min=0.836, max=0.948). The measure of internal consistency was excellent ($\alpha = 0.931$). Construct validity for the eHEALS scale was supported by significant positive correlations with the Internal Locus of Control of Behavior and the General Self-Efficacy Scale, the frequency of searching for information on one's health, perceived expertise with technology, frequency of Internet use, perceived Internet expertise and a negative correlation

with external locus of control. *Conclusions***:** The Italian version of the Health Literacy Scale (eHEALS) is valid and reliable in assessing the ability to collect, evaluate, and apply health information to health problems amongst the general Italian population.

Keywords: eHeals, Health Literacy, Confirmatory Factor Analysis, Italian validation.

Introduction

Since the onset of the SARS-CoV-2 pandemic, digital technology across the global population has become the primary method of both communication and to access health information; specifically, obtaining answers on health inquiries, recognizing symptoms, methods of precaution to be taken, and the most effective treatments to follow for health problems. As a result, the need for digital literacy has grown exponentially.

Health literacy represents the individual's ability to obtain, process and understand basic health information, the functioning of health services, and information relating to personal health (e.g., individual pathology, eating habits, physical behavior, etc.), that are critical for individuals to make appropriate health decisions (Ratzan et al., 2000). Health literacy represents not only a range of skills going over the individual ability to read and take in information, but also the ability to control individual and societal factors that may have an impact on their health (Ratzan, et al. 2000).

Modern technology allows people to search for various information on the Internet, including health information, through a wide range of electronic devices such as smartphones, tablets and PCs connected to Wi-Fi or mobile networks. For example, the Pew Research Internet Project estimates that over 85% of American adults use the Internet, and nearly three-quarters of them have searched for health information online. (Pew Research Center, 2016). Despite this, it is useful to specify that the ability to search for health information differs from the ability to interpret health information (Norman & Skinner, 2006). Specifically, people may not have the skills to understand such information or may not have sufficient knowledge for the correct interpretation of information found on the Internet (Norman & Skinner, 2006; Institute of Medicine, 2004; 2011).

For this reason, assessing the degree of health literacy, for the general population, is considered a fundamental prerequisite for health professionals who intend to promote e-health resources to patients who may need them (Norman & Skinner, 2006).

Digital health (eHealth) literacy is defined as "*the ability to browse and obtain health information*" (Nguyen et al., 2016). Digital health literacy (eHealth) can be a challenge for the general population and patients, given

the need to understand its many components, including "i) traditional literacy, ii) health literacy, iii) information literacy, iv) scientific literacy, v) media literacy and vi) information literacy" (Norman & Skinner, 2006). More specifically, users should have the knowledge to access, retrieve, and evaluate the information they obtain online (Norman & Skinner, 2006). Users are likely to be exposed to different types and qualities of information, highlighting the need to compare and further evaluate the information. Also, due to the rapid change in both care routines and technology, health information is updated quickly. Furthermore, searching online about one's own health state, sometimes fairly accurate or inexact (for example, one consumes information from sources whose reliability and trustworthiness is unknown) is correlated with subsequent worries, anguish, and anxiety (Starcevic & Berle, 2013).

In 2006, Norman and Skinner (2006) developed the eHealth Literacy Scale (eHEALS) as a tool to measure digital health literacy. The eHEALS is a self-assessment scale which provides data on the perception of an individual's own knowledge and skills when collecting and understanding health-related information online. Thanks to its simple and fast administration, it has been validated in different populations and translated into various languages such as Japanese (Mitsutake et al., 2012; 2016), Chinese (Koo et al., 2012), Dutch (Van der Vaart et al., 2011), Spanish (Aponte & Nokes, 2015), Swedish (Wångdahl et al., 2020) and finally, Italian (Bravo et al., 2018). The eHEALS test is designed to provide a general estimate of mainstream eHealth literacy that can be used to tailor clinical decision making and in health promotion planning.

It can be assumed that there is a link between digital health literacy and the general use of technology (Norman & Skinner, 2006). Individuals accustomed to technology will most likely increase their ability to use it as a tool to find information online on health problems. Consequently, it becomes unsafe when such information is false, misleading or of low quality (Eysenbach, 2001; 2002). The availability of tools and resources to evaluate the qualitative level of people's comprehension and ability to use health information on the web allows healthcare professionals (e.g., doctors, psychologists) to protect online users from possible risks, and at the same time increase their responsibility (Eysenbach, 2001; 2002).

Health portals developed by governmental and non-profit organizations are very useful, as they offer reliable information and discourage populations from consuming information from unsafe sources, with some limits (e.g., the impossibility of analyzing all information accessible on the web). (Norman & Skinner, 2006). Individuals without digital and health literacy skills should be also considered. Consequently, the figure of an "expert", able to facilitate the process of screening the most relevant health information for the users, could be necessary (Klecun, 2010).

Regardless of the population of interest, the need to consume information on the Internet with confidence is particularly important when considering health-related problems; where the consequences of trusting low-quality, misleading or even false information are not negligible and can undermine the trust between patients and healthcare professionals with a negative impact on the effectiveness of treatments (Fan et al., 2020).

Complementarily, Hirji (2004) points out that many users are not adequately trained in information retrieval skills, and this is overlooked by many website designers and health care providers who publish information online. The author cites studies which seem to indicate that people overestimate their ability to judge accurate material online. Essential skills for evaluating web-based information are identified by Edgar et al. (2002), such as the ability to conduct a search to find the "right" sites; the ability to judge the quality of information; and the ability to synthesize such information in a context useful for personal/individual health. Although this is a useful approach, it presents some limitations, including the inability to track all health information online. Therefore, the promotion of people's ability to critically analyze the data found remains a priority (Hirji, 2004; Wyatt et al., 2003; Klecun 2010).

Many researchers (Robbins & Dunn, 2019; Wakefield et al., 2017; Vaart & Drossaert, 2017) point out that digital health literacy requires skills complementary to those of general and health literacy skills. The eHEALS scale, can allow the clinician/researcher to understand the person's skills and awareness on health issues. The eHealth scale could therefore be an adequate tool to assess the degree of capability for a patient to seek health information online (Cuthbert & Aggarwal, 2020).

The Italian version of the eHEALS scale (Bravo et al., 2018) was validated using the PCA (Principal-Component Analysis) technique. However, existing literature recommends a more solid and complete validation, for instance, subjecting the scale itself also to a Confirmatory Factor Analysis (CFA), as the PCA can also be used as an initial step in CFA because it can provide information regarding the maximum number and nature of factors (Kim, 2008). However, because measuring health constructs is complex, scale development and construct validation studies usually suggest CFA only after having used exploratory techniques to investigate the latent structure (Edwards, 2010).

Furthermore, convergent construct validity was examined using mainly demographic variables (e.g., age, sex, educational qualification), frequency of Internet access to search for health information. To strengthen validity (i.e. construct, nomology, convergent and discriminant), in addition to the original research (Bravo et al., 2018), further tests, theoretically connected to the eHEALS (eHealth Literacy Scale), were evaluated in the sample: (*i*) Self-esteem (Rosemberg's self-esteem scale); (*ii*) Anxiety (The Anxiety – Adult PROMIS Emotional Distress - Anxiety - Short Form) (*iii*) Locus of Control of Behavior (Test Locus of Control of Behavior -LCB)

(*iv*) and General Self-Efficacy (General Self-Efficacy Scale). These scales were used because accurate research of information about one's health, discovered using electronic tools, seemed to be associated with lower levels of anxiety (e.g., Bayrampour et al., 2019), higher self-esteem (Wolf et al., 2016), higher internal locus of control (Vajaean & Baban, 2015) and a higher sense of self-efficacy (Ditzler et al., 2016).

The objective of the study is: (*i*) to calculate the main indicators of good fit (e.g., Goodness Fit Index) performing the Confirmatory Factor Analysis (CFA), (*ii*) to evaluate the correlation of the eHEALS test with self-esteem, anxiety, self-efficacy, locus of control, general efficacy and (*iii*) to confirm the one-dimensional factorial structure of the eHEALS.

The research was conducted in accordance with the Declaration of Helsinki for medical research involving human subjects and was approved by the Roman Institute of Integrated Psychodynamic Psychotherapy (IRPPI) in Rome, Italy. All participants gave their consent to participate in the study. The identity of the participants remains anonymous, and the data was stored in an encrypted online archive, accessible only to the authors of this study.

Methods

Participants

Between January and February 2021, a link to the online survey was published across several Italian social network community forums (i.e., Facebook). Inclusion criteria were the following: (*i*) at least 18 years old; (*ii*) understanding of the Italian language; (*iii*) acceptance of informed consent. Participant anonymity was guaranteed ((the data was stored in an encrypted online database). Three hundred and forty-nine volunteers completed the online survey. Participants who joined voluntarily provided consent online.

Females comprised the majority of the sample (n= 274; 78.5%), with a median level of education falling in the “High school” category (see Table 1), and mean age of 40 years (SD ± 13). Furthermore, the mode (the category in which the most participants identified with) of the romantic relationship status resulted in the category "Married" (42.7%, n = 149, see Table 2). The mode for the occupation category was found to be “Worker” (54%, n = 189, the other category was 11.5% Unemployed, 16.5% Student, 3.5% Retired, 14.5% Other). Furthermore, the most used tool to search for information was the “Smartphone” category (71%, n = 248, the other category was 3.7% Other, 22.6% PC-Notebook, 2.7% Tablet). The results of the main test used (mean ± SD) are summarized in Table 3. Lastly, all participants completed the entire online form, therefore there was no missing data.

Table 1. Education level of Sample (n=349)

Education level	Frequency	Percent	Valid Percent	Cumulative Percent
Post graduate title	59	16.905	16.905	16.905
Middle school	12	3.438	3.438	20.344
High school	124	35.530	35.530	55.874
University degree	154	44.126	44.126	100.000
Total	349	100.000		

Table 2. Relationship status (n=349)

Relationship status	Frequency	Percent	Valid Percent	Cumulative Percent
Divorced	11	3.152	3.152	3.152
Fiancé	93	26.648	26.648	29.799
Separated	15	4.298	4.298	34.097
Single	75	21.490	21.490	55.587
Married	149	42.693	42.693	98.281
Widowed	6	1.719	1.719	100.000
Total	349	100.000		

Instruments

Socio-demographic questions and the use of the Internet for health research. Socio-demographic information of participants (e.g., gender, age, educational level, relationship status, employment status) were collected. In addition, participants were asked questions pertaining to their use of the Internet and subsequent search behaviours for health information using the following questions: "*How often have you searched for information about your health on the Internet in the last 12 months?*"? (using a 5-point Likert scale, where 1 is never and 5 is very often; "What *devices do you generally use to search for information about your health?*" with multiple answers: PC, Tablet, Smartphone, and others. A further question was "*How often do you use the Internet in a week*?", with a 5-point Likert scale, where 1 = Never and 5 = Very often. In addition, the following questions were asked "*How competent do you feel in using the Technology*" and "*How competent do you feel in using the Internet*?" with response on a Likert scale (1 = Not competent at all and 5 = Very competent). A further question was "*During the Covid-19 quarantine, did your research on health information on the*

web increase?" with a Likert response from 1 to 5 points, where 1 = Not at all and 5 = Very Often.

eHEALS scale. The eHEALS (eHealth Literacy Scale) includes 8 items evaluated on a 5-point Likert scale (score 1 as strongly disagree; score 5 as strongly agree), where a higher score indicates a higher level of confidence in the ability to find, rate and use the health information for making health-related decisions. In short, a higher score represents increased perceived eHealth literacy (Paige et al., 2017). Example of an item is "*I know how to find health information on the Internet*". The Italian version of the eHEALS was applied (Bravo et al., 2018). The alpha of Cronbach in this study was 0.931.

Rosenberg's Self-Esteem Scale (RSES; Rosenberg, 1965): The 10-item Italian version (Prezza et al. 1997) was used to assess self-esteem (for example, "*Overall, I am satisfied with myself* ") using a four point Likert-type scale from 0 (strongly in disagree) to 3 (strongly agree). Scores vary between 0 and 30, with the highest scores indicating greater self-esteem. The alpha of Cronbach in this study was 0.864. This test reveals that a person with higher self-esteem is associated with better management of health information (Wolf et al., 2016).

Anxiety – Adult (PROMIS Emotional Distress – Anxiety – Short Form). The 7-Item Adult PROMIS Emotional Distress / Anxiety-Short Form (APEDA-SF) test (Pilkonis et al., 2011; Italian version: Fossati et al. 2015) evaluates anxiety among adults. The seven items (e.g., "*I feel anxious*") are rated on a scale of 1 (never) to 5 (very often) with scores ranging from 7 to 35. A higher score indicates higher levels of anxiety. The Cronbach alpha in this study was 0.918. The use of correct health information seems to be associated with low anxiety (Deady et al., 2017; Bayrampour et al., 2019).

Locus of Control of Behaviour (LCB, Craig et al., 1984). The LCB is a test consisting of 17 items (e.g., "*When I make plans, I am almost certain that I can make them work*") rating on Likert scale from 0 to 5 (0 = completely disagree, 5 = completely agree). Seven questions (1,5,7,8,13,15 and 16) evaluate the internal locus control, the others evaluate external locus control. The indicative value of the 17 answers consists of the sum of the scores on the external control in addition to the inverted scores of the questions relating to internal control (Farma & Cortinovis, 2001). The alpha of Cronbach in this study was 0.700. The use of correct health information seems to be associated with a major locus of internal control (Vajaean & Baban, 2015).

General Self-Efficacy Scale (Italian version Sibilia et al., 1995; original version Schwarzer & Jerusalem, 1995). This scale was created to assess the general level of perceived self-efficacy in predicting and planning how to cope and adapt to everyday problems after experiencing stressful life events. The scale is usually self-administered, as part of a more

comprehensive questionnaire. Answers are scored on a 5-point Likert scale (1= Not at all true 5= Exactly true). To calculate the overall score, the responses to all 10 items are added together to obtain the final composite score with a range of 10 to 50. A higher score indicates greater overall self-efficacy. Cronbach's alpha in the present study was 0.928. The use of correct health information seems to be associated with greater self-efficacy (Ditzler et al., 2016). An example is "*I can always manage to solve difficult problems if I try hard enough*".

Preliminary statistical analysis

The univariate normality of the data was investigated first using the guidelines proposed by Muthén and Kaplan (1985) which outline an asymmetry and a kurtosis in the interval from −1 to +1 as the ideal range of items or Shapiro-Wilk normality test are not significant for $p < 0.01$ (Mishra et al., 2019). Furthermore, descriptive statistics concerning the items (i.e., frequencies, percentages) were calculated. The performed statistical analysis were the following: (*i*) descriptive statistics of the eHEALS test items (i.e., means and standard deviations); (*ii*) criterion/convergent/ concurrent validity of the eHEALS test; (*iii*) the reliability of the scale, examined by composite reliability (CR) (CR values greater than 0.7 are associated with a strong test reliability; Fornell & Larcker 1981).

The evaluation of the factorial structure and the dimensionality of the Italian eHEALS was evaluated using Confirmatory Factor Analysis (CFA). The best sample size to carry out a factor analysis varies between 30 and 500 units (Roscoe, 1975). Moreover, the minimum sample size for this study must be 340, considering the following factors: Confidence Level (95%), Margin of Error (5%), population size (> 20.000) (e.g., Kadam, 2010). In addition, from 5 to 10 observations for each variable are needed (Hair et al., 2010). Specific indicators were also calculated to ascertain the one-dimensionality of the test (Ferrando & Lorenzo-Seva, 2017): UNICO (one-dimensional congruence> 0.95), ECV (common variance> 0.80.) Furthermore, the indices recommended by Kline (2015), for the CFA, were adopted to delineate a good factorial model in the following way (as follows): NNFI (Non-Normed Fit Index ≥ 0.95), CFI (Comparative Fit Index ≥ 0.95), GFI (Goodness Fit Index ≥ 0.95), AGFI (Adjusted Goodness Fit Index ≥ 0.95), RMSEA (Root Mean Square Error of Approximation ≤ 0.08), and RMSR (Root Mean Square of Residuals ≤ 0.8) and with an acceptable saturation on all items ($\lambda ij \geq 0.50$, Ferguson & Cox, 1993). The reliability of the data was assessed through the following indicators: Cronbach's Alpha (α) (Cronbach, 1951; 1955), McDonald's Omega (ω) (Mcdonald, 1999) and Composite Reliability (CR). The analyzes were performed using FACTOR v.10.10.3 (Lorenzo-Seva & Ferrando, 2006), SPSS Statistics v.20 (IBM Corporation, 2011), Jasp version 0.13.1 (JASP Team, 2020), the Mann Whitney U calculator (2017).

Table 3. Descriptive Statistics of main tests used

	eHEALS	Anxiety	GSE	Self esteem	LOCINT	LOCEST
Valid	349	349	349	349	349	349
Missing	0	0	0	0	0	0
Mean	27.499	20.461	32.897	22.066	24.937	18.837
Std. Error of Mean	0.401	0.380	0.339	0.307	0.248	0.474
Std. Deviation	7.494	7.106	6.326	5.727	4.635	8.852
Minimum	8.000	7.000	11.000	3.000	9.000	0.000
Maximum	40.000	35.000	45.000	30.000	35.000	49.000

Note: eHEALS= eHEALS scale, Anxiety= PROMIS Emotional Distress – Anxiety – Short Form, GSE= General self-efficacy scale, Self-esteem= Rosenberg's Self-Esteem Scale, LOCINT= Internal locus of control of behaviour scale, LOCEST= External locus of control of behaviour scale

Results

Confirmatory Factorial Analysis (CFA)

The present study analyzed the distribution of the eight items of the Italian eHEALS scale. Most items (see Table 4) were distributed asymmetrically (i.e., negative asymmetry, with the highest frequencies in the high values). As for asymmetry and kurtosis, some items were distributed in a substantially non-normal way (the items do not fall within the range of ± 1 *or* Shapiro-Wilk normality test are significant for $p < 0.01$, this confirms that the items are not all normally distributed, see Muthén & Kaplan 1985; Mishra et al., 2019). Moreover, the Italian eHEALS scale appeared to have a unidimensional structure (i.e., a single factor); it had eigenvalues > 1 in a single factor model (i.e., Gorsuch, 1983) which suggests one factor as the optimal usable model (more specifically, the eigenvalues = 5.91 with ECV=0.73) and UNICO= 0.988, confirming the findings in the original research (Bravo et al., 2018).

Since there is no single consensus in the literature (Bollen & Long 1993; Boomsma, 2000), different goodness of fit (GOF) indices were used to confirm the dimensionality of the eHEALS. In this specific case, since the elements (see Table 4) were distributed in a substantially non-normal way (some items outside the range of ± 1), we used the Diagonal Weighted Least Squares (DWLS, polychromic correlation) method in the confirmatory factor analysis (estimation method), whit 95% Confidence Interval and 1000 Bootstrap samples (Koğar & Yilmaz, 2015). The results showed the following: χ^2=30.602 (*df*=20, *p*=0.061, i.e. not significant) whit

χ^2/df= 1.53 (Chi Square/degree of freedom ratio <3 for a good model, Hu & Bentler, 1999; Schumacker, & Lomax, 2010), Comparative Fit Index (CFI)= 0.99, Tucker-Lewis Index (TLI)=0.99, Bentler-Bonett Non-Normed Fit Index (NNFI)= 0.99, Root mean square error of approximation (RMSEA)=0.039, Goodness of fit index (GFI)=0.99.

Furthermore, all items have a significant ($p<0.01$) and high (>0.50) factor loading, ranging from 0.836 to 0.948 (see Figure 1, Table 5, 6 for details). These results confirm an excellent factorial structure and excellent validity of the investigated construct (Cronbach & Meehl, 1955). Although the single eHEALS items are distributed in a non-normal way, the total score of tests used (including the eHEALS test) and the sample size, allows to use the data approximated to normality (the assumptions of normality are respected (for the total score of the test) as assessed by standardized residue analysis, see Doob, 1938; Tchebycheff, 1980) in subsequent analysis (e.g., ANOVA, Pearson's r correlation).

Table 4. Descriptive Statistics of the eight items (eHEALS)

	ITEM 1	ITEM 2	ITEM 3	ITEM 4	ITEM 5	ITEM 6	ITEM 7	ITEM 8
Valid	349	349	349	349	349	349	349	349
Missing	0	0	0	0	0	0	0	0
Mean	3.542	3.427	3.496	3.453	3.567	3.542	3.756	2.716
Std. Error of Mean	0.056	0.058	0.059	0.059	0.057	0.064	0.062	0.070
Std. Deviation	1.054	1.093	1.095	1.107	1.072	1.197	1.165	1.312
Skewness	-0.510	-0.377	-0.405	-0.417	-0.606	-0.483	-0.711	0.221
Std. Error of Skewness	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131
Kurtosis	-0.160	-0.531	-0.481	-0.431	-0.097	-0.648	-0.428	-1.045
Std. Error of Kurtosis	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260
Minimum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Maximum	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000

Table 5. Fit indices (eHEALS CFA)

Index	Value
Comparative Fit Index (CFI)	0.997
Tucker-Lewis Index (TLI)	0.995
Bentler-Bonett Non-normed Fit Index (NNFI)	0.995
Bentler-Bonett Normed Fit Index (NFI)	0.990
Parsimony Normed Fit Index (PNFI)	0.707
Bollen's Relative Fit Index (RFI)	0.986
Bollen's Incremental Fit Index (IFI)	0.997
Relative Noncentrality Index (RNI)	0.997

Table 6. Factor loadings eight item of eHEALS

						95% Confidence Interval		
Indicator	Symbol	Estimate	Std. Error	z-value	p	Lower	Upper	Std. Est.
ITEM 1	λ1	0.885	0.033	27.106	< .001	0.787	0.975	0.839
ITEM 2	λ2	0.940	0.034	28.021	< .001	0.854	1.015	0.861
ITEM 3	λ3	0.920	0.034	27.277	< .001	0.827	1.001	0.841
ITEM 4	λ4	0.948	0.034	27.815	< .001	0.853	1.030	0.856
ITEM 5	λ5	0.920	0.034	27.360	< .001	0.829	0.998	0.858
ITEM 6	λ6	0.897	0.035	25.872	< .001	0.777	1.001	0.749
ITEM 7	λ7	0.836	0.034	24.881	< .001	0.717	0.936	0.718
ITEM 8	λ8	0.869	0.035	24.915	< .001	0.751	0.967	0.662

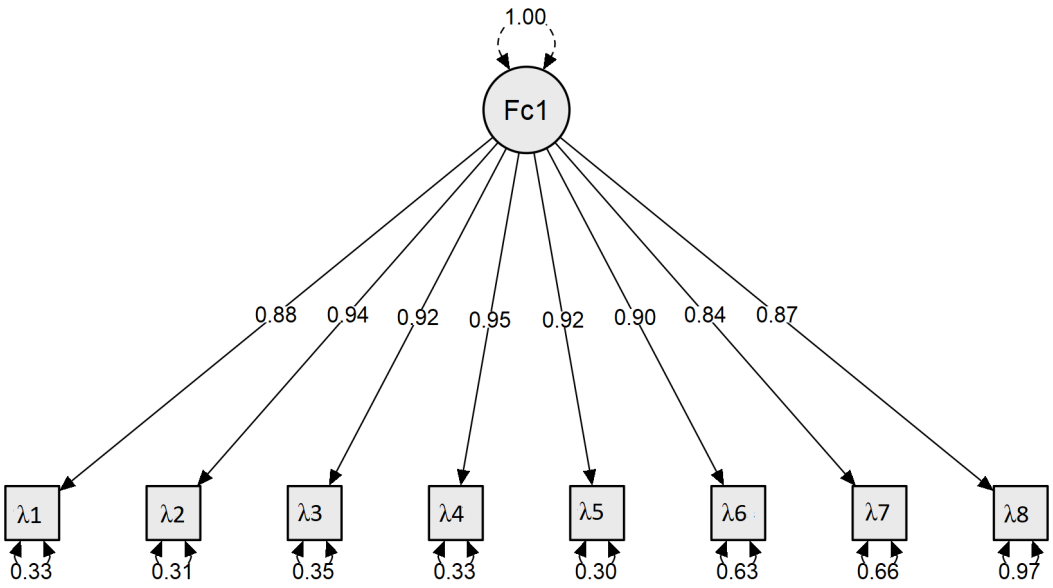

Figure 1. Factor loading - eight items of eHEALS scale

Criterion/ Construct Validity

After Confirmatory Factorial Analysis, different types of reliability (e.g., internal consistency) and validity (e.g., construct validity, criterion validity) were investigated. To carry out these analysis, different items of the eHEALS test were correlated with each other, alongside the total of the eHEALS test itself (Cronbach, & Meehl, 1955). Furthermore, the eHEALS test total was correlated with several other tests and variables, theoretically related to the "eHEALS" construct (Campbell & Fiske, 1959). All eight items of the eHEALS test were found to be significantly and positively correlated with each other (min=0.496, max=0.834, $p<0.01$) and with the eHEALS total test score (min=0.780, max=0.867, $p <0.01$). The total eHEALS test correlates significantly ($p <0.05$) and positively with; the GSE test ($r = 0.178$), the internal locus of control test ($r = 0.224$), the frequency of searching for information on one's health ($r = 0.246$), perceived Technology expertise ($r = 0.446$), frequency of Internet use ($r = 0.282$), frequency of searching for information during quarantine ($r = 0.235$) and with perceived Internet expertise ($r = 0.494$). In addition, the total of the eHEALS test is positively correlated with self-esteem ($r = 0.032$, $p= 0.550$), although not statistically significant. The total eHEALS test is negatively correlated with anxiety, although not statistically significant ($r = -0.93$, $p = 0.178$) and to the external locus of control ($r=-0.146$, $p <0.05$). See Table 7,8 for details.

Table 7. Pearson's Correlations among the main tests used

Variable	eHEALS	Anxiety	GSE	Self esteem	LOCINT	LOCEST
eHEALS	—					
Anxiety	-0.093	—				
GSE	**0.178 *****	**-0.276 *****	—			
Self-esteem	0.032	**-0.483 *****	**0.561 *****	—		
LOCINT	**0.224 *****	**-0.137 ***	**0.576 *****	**0.367 *****	—	
LOCEST	**-0.146 ****	**0.474 *****	**-0.254 *****	**-0.419 *****	**-0.217 *****	—

Note: * p < .05, ** p < .01, *** p < .001. eHEALS= eHEALS scale, Anxiety= PROMIS Emotional Distress – Anxiety – Short Form, GSE= General self-efficacy scale , Self-esteem= Rosenberg's Self-Esteem Scale, LOCINT= Internal locus of control of behaviour scale , LOCEST= External locus of control of behaviour scale

Table 8. Correlations' matrix: eHealth vs Technological and digital attitude/expertise

Variable	Health information search	Technology expertise	Internet use	Search information during quarantine	Internet expertise	eHEALS
Health information search	—					
Technology expertise	**0.166 ****	—				
Internet use	0.059	**0.345 *****	—			
Search information during quarantine	**0.456 *****	**0.181 *****	**0.123 ***	—		
Internet expertise	**0.113 ***	**0.751 *****	**0.342 *****	**0.174 ****	—	
eHEALS	**0.246 *****	**0.446 *****	**0.282 *****	**0.235 *****	**0.494 *****	—

Note: * p < .05, ** p < .01, *** p < .001

Reliability

To analyze the reliability of the eHEALS and internal consistency, Cronbach's alpha, Composite Reliability (CR) and McDonald's Omega were calculated. In our study, Cronbach's alpha was α= 0.931, McDonald's Omega was ω= 0.932 and the CR was 0.932 (for a defined construct with eight items is necessary to meet a minimum threshold of 0.80, Netemeyer et. al., 2003). These results confirm a strong reliability of the test (see Table 9).

Table 9. Item Reliability Statistics (eHeals scale)

Item	If item dropped	
	ω	α
ITEM 1	0.920	0.920
ITEM 2	0.918	0.918
ITEM 3	0.920	0.920
ITEM 4	0.919	0.918
ITEM 5	0.918	0.918
ITEM 6	0.925	0.925
ITEM 7	0.927	0.927
ITEM 8	0.931	0.930

In addition, we conducted an ANOVA (Analysis of Variance) between the education level groups (defined as A = Middle and High school, B [n= 136] = University degree [n=154], C = Post-graduate Degree [i.e., Ph.D., n= 59]) and the eHEALS total. The results were as follows: $F = 11.644$, $p < 0.01$ ($\eta^2 = 0.063$) with group C (Post-graduate Degree) having the highest average (see Table 10,11). The model is therefore significant. In addition, we verified whether there was a difference in gender in the use of eHEALS (total scoring), by carrying out an ANOVA with the following results: $F = 0.027$, $p = 0.871$, with the results being statistically insignificant.

Table 10. ANOVA Between eHEALS total score and Education level

Cases	Sum of Squares	df	Mean Square	F	p	η^2	η^2_p
Education Level	1232.443	2	616.221	11.644	< .001	0.063	0.063
Residuals	18310.806	346	52.921				

Table 11. Descriptive - ANOVA Between eHEALS total score and Education Level

Education Level	Mean	SD	N
A	25.449	7.676	136
B	28.078	7.100	154
C	30.712	6.752	59

Note: A= Middle School and High School, **B**= University degree **C**= Post graduate title

Limitations

A few limitations of this study must be discussed. In the first place, a convenience sampling was adopted, therefore it may not be as representative of the reference population compared to a random one. Secondly, even if the internal coherence of the data was analyzed, it is acknowledged that self-reports suffer from bias (ultimately classified as content-related or content-free (Althubaiti, 2016). Lastly, as previously mentioned, the higher proportion of female participants may also interfere with results' inference.

Discussion and Conclusions

Despite these limitations, the eHEALS test appears to be a valid and reliable scale to measure eHealth competence (i.e., eHealth literacy) amongst the Italian adult population. The information available to the public can influence personal health decisions and, subsequently, the effectiveness and outcome of public health measures implemented by health services. A critical review of the accessibility, quality and nature of information sources is now required.

As a result, there is a need for higher quality online health resources to facilitate public information, this useful for promoting better cooperation with public health.

The goal of this study was to contribute to strengthen the Italian version of eHEALS scale (validation and initial translation by Bravo et al., 2018) making it more valid and reliable, using various statistical techniques (e.g., Confirmatory Factor Analysis, CFA), and to confirm the relationship between eHEALS and other measures of convergent/divergent constructs. The results indicate a one-dimensional structure of the test, confirming what was previously found by the original study (Norman & Skinner, 2006) and supporting other international validations (e.g., Pérez et al., 2015; Aponte & Nokes, 2015; (Mitsutake et al., 2012, 2016; Koo et al., 2012; Van der

Vaart et al., 2011). Psychometric analysis has shown that eHEALS has good internal reliability and consistency.

The construct and criterion validity were confirmed by the significant correlation between the test items and test totals, and by significant correlations with the GSE test (general self-efficacy scale), Internal locus of control of behavior scale, Health information search, technology expertise, Internet use and Internet expertise. Furthermore, even if not statistically significant, the total test is positively correlated with the self-esteem test (Rosenberg's Self-Esteem Scale) and negatively correlated with the Anxiety test (PROMIS Emotional Distress - Anxiety - Short Form). These results support findings in previous studies (Norman & Skinner, 2006; Starcevic & Berle, 2013). The use of this methodology and scales, theoretically related to the measurement of eHEALS, allow the present study to provide strong validity of criterion and construct (e.g., James, 1973).

In fact, a greater sense of self-efficacy was found to be associated with a greater ability to search for health information correctly (Norman & Skinner, 2006) which in turn leads to reduced anxiety (Norman & Skinner, 2006). It is also not surprising that a greater perceived sense of technology and Internet expertise is associated with a higher scoring in the eHEALS test. In fact, generally, as shown by previous studies (Norman & Skinner, 2006), a greater sense of perceived self-efficacy (in this case, feeling competent in the use of technology and in the use of the Internet) is associated with a general better research information about health.

The frequency of searching for information, the frequency of internet use, and the frequency of use of technology in general, have previously been found positively correlated to the eHEALS test (Norman & Skinner, 2006; Wångdahl et al., 2020). Individuals who use technology and the Internet will most likely indicate an increase in the ability to use technology as a help tool over time.

The positive correlation between the eHEALS test and an increase in the search for information in a period of quarantine also supports our initial hypotheses: the SARS-CoV-2 (COVID-19) pandemic led many people to research information about the virus, the pandemic, and health in general (Do et al., 2020).

Furthermore, in previous research (e.g., De Caro et al., 2016), the eHEALS test was found to be significantly correlated with self-esteem. In our study, we found a positive, however not statistically significant correlation for self-esteem, and a positive and statistically significant correlation with self-efficacy. Self-efficacy and self-esteem, although connected to each other, are not the same construct (self-esteem is the extent to which one appreciates, loves, and values oneself (e.g., Smith et al., 2007), while self-efficacy is defined as judgments that people have about their abilities to be able to obtain certain types of services (e.g., Bandura, 2010). This difference may be due to the cultural differences in which these searches were carried out, or the type of sample recruited.

The level of education, on the other hand, seems to make a difference. In our study, a higher total score on the eHEALS test is associated with higher levels of education. This is not surprising, as more education is generally associated with better and more effective search habits for health information (Wångdahl et al., 2020) although literacy levels decline in the general population after age 45 (Barrett & Riddell, 2019).

In conclusion, future research is needed considering an alternative recruitment method that could guarantee a more representative sample of the Italian adult population.

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Declaration of conflict of interest

The authors declare that they have no conflict of interest.

Availability of data and material: The data is available in case of a reasonable request.

Ethics Approval and informed consent

All procedures performed in this study involving human participants were in accordance with the ethical standards of the research team's organizational Ethics Board and the 1975 Helsinki Declaration. Informed consent was obtained from all participants.

Authors Contributions

All authors participated in the writing of the following research.

Appendix:

List of items examined (Italian eHEALS scale):

Item 1: *So come trovare su Internet informazioni utili alla salute*
Item 2: *So come usare Internet per rispondere alle domande riguardanti la mia salute*
Item 3*: So quali informazioni sulla salute sono disponibili su Internet*
Item 4*: So dove trovare su Internet informazioni utili sulla salute*
Item 5*: So come usare le informazioni sulla salute che trovo su Internet in modo che mi possano essere d'aiuto*
Item 6*: Ho le capacità che mi servono per valutare le informazioni sulla salute che trovo su Internet*
Item 7*: Posso distinguere la bassa o alta qualità delle informazioni sulla salute che trovo su Internet*
Item 8*: Mi sento sicuro nell'usare informazioni che trovo su Internet per prendere decisioni riguardo la mia salute*

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